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SEASONING AND SURFACING DEGRADE IN KILN-DRYING WESTERN HEMLOCK IN WESTERN WASHINGTON

by

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The potential lumber yield and value of saw logs can be appreciably affected by losses of volume and grade during sawing, seasoning, and surfacing.

There are relatively few reported studies of degrade losses, and it is assumed that most lumber manufacturers have to estimate the seasoning and machining losses that occur in their operations. Results obtained in one study cannot be used to predict losses that would occur in processing timber from a different area or in manufacturing at a different plant. Nevertheless, the recent findings, reported here, of one company do indicate where serious losses can occur.

In 1962 this study, involving more than 175,000 board feet of lumber, was made on the Olympic Peninsula in Washington to determine the degrade (loss in volume and value) of western hemlock cut, kiln-dried, and surfaced in accordance with usual industry practices. The degrade measured included (1) the reduction in grade due to seasoning, surfacing, and manufacturing defects and (2) the loss in volume due to culling and trimming of surfaced dry lumber. Degrade is expressed both as a percentage of the rough green lumber input and as a loss in value per thousand board feet of lumber.

STUDY PROCEDURE

All lumber was first carefully graded, marked, and tallied in the rough green condition at the sawmill to establish its potential grade^{1/} and value. It was kiln-dried under the usual production schedules of the mill, then surfaced, transported to the yard, and carefully regraded. Pieces that had been misgraded, because of difficulty in discerning all characteristics in the rough green condition, were eliminated and the original tally corrected accordingly. The difference between the potential grade and volume of rough green lumber (corrected input) and the final grade and volume of surfaced dry lumber (output) is recorded as degrade.

Grading in both the rough green and surfaced dry condition was done by the same Pacific Lumber Inspection Bureau grader. Lumber was graded under Standard Grading and Dressing Rules Number 15 of the West Coast Lumber Inspection Bureau.

All Dimension stock was dried in relatively new end-loaded, steam-heated, internal fan, double-track kilns with automatic temperature and humidity controls. A typical company schedule for drying the Dimension is shown in table 1. No conditioning or equalizing treatments were used to relieve casehardening stresses. Planer feed speeds ranged from 475 feet per minute for 2 by 10's to 625 feet per minute for 2 by 4's.

Shake was included in this study as a seasoning defect, although it was omitted in a previous degrade study of western hemlock in western Oregon.^{2/} Shake was treated as a seasoning defect because the company had only recently installed dry kilns and was interested in learning the degrade experienced in changing from a surfaced green shipping basis to a surfaced dry. Whether shake is a true seasoning defect or not, its inclusion provides sawmill operators with some indication of the losses that can occur in drying a species containing shake.

^{1/} Potential grade is the surfaced dry grade of lumber one could expect to obtain from the green lumber if no defects resulted from sawing, seasoning, or surfacing.

^{2/} Knauss, A. C., and Clarke, E. H. Seasoning and surfacing degrade in kiln-drying western hemlock in western Oregon. U.S. Forest Serv. Pac. NW. Forest & Range Expt. Sta. Res. Note 207, 11 pp. 1961.

Table 1.--Typical kiln-drying schedule for western hemlock;1962 study in western Washington

Thickness and grade	:	:	Temperature		:	Equilibrium moisture content
	:	Time from	:	:		
	:	start of	:	:		
	:	drying	:	Dry bulb	Wet bulb	
<hr/>						
		<u>Hours</u>	----	<u>Degrees F.</u>	-----	<u>Percent</u>
2-inch Dimension		0		155	145	11.7
		20		160	145	9.4
		38		165	145	7.9
		54		170	142	6.2
		62		175	142	5.5
		70		180	142	4.6
		94		out	--	--

RESULTS AND DISCUSSION

Grade Recovery

The rough green lumber inputs and the surfaced dry lumber outputs are shown by amount and grade in tables 2 and 3. The proportion of lumber that remained ongrade, the proportion that changed in grade, and the volume loss in cull and trim are shown for each grade-thickness item.

Seasoning, Surfacing, and Manufacturing Degrade

The types of seasoning, surfacing, and manufacturing defects that occurred in the study lumber and the proportion of degrade caused by each are shown in table 4. The degrade shown by this study for 1-inch Finish may not be representative of industry experience in general, since this mill was cutting primarily for 2-inch Dimension. The 1-inch Finish was developed from side-cut lumber or by resawing and re-edging 2-inch material. After kiln-drying, the thickness of Dimension lumber was insufficient to permit satisfactory planing of the resawn 1-inch boards, and the degrade was substantially greater than it would be at a mill sawing for 1-inch Finish. At this mill, the emphasis was on efficient sawing of 2-inch Dimension, and the small volume of 1-inch Finish that was developed was sold locally in a surfaced green condition without degrade.

Loss in value per thousand board feet (using average prices for the Douglas-fir region) occasioned by each seasoning, surfacing, and manufacturing defect is shown in table 5. Although the values in table 5 should not be considered absolute, i. e., total loss for Construction 2 by 4's for any given time may never be exactly \$6.01, they should be important and useful when considered as relative values. For instance, examination of the table should be helpful in determining areas in the manufacturing process that could be improved.

Each manufacturer should find it profitable to determine individually the major causes of degrade losses. Such information can be determined by two men--a grader and a tallyman--and will permit management to make decisions based on facts rather than estimates. Experiment Station staff members will be glad to assist interested operators in developing simplified degrade study procedures to fit their needs.

Table 2.--Grade recovery of western hemlock Finish lumber following kiln-drying and surfacing; 1962 study in western Washington

Rough green lumber input				Grade recovery of surfaced dry lumber as percent of input							
Thickness and grade	Width	Corrected volume tested	C and better	D	Construc- tion	Standard	Utility	Economy	Cull and trim loss	Total degrade	
<u>Inches</u>			<u>Percent</u>								
1-inch Finish:											
C and Better	4	914	42.6	21.4	--	18.0	16.5	0.3	1.2	57.4	
	6	1,958	48.4	8.0	6.6	25.4	9.4	.5	1.7	51.6	
	8	2,451	52.4	6.5	4.9	22.9	8.9	2.0	2.4	47.6	
D	4	59	--	69.4	--	15.3	15.3	--	--	30.6	
	6	196	--	68.4	--	20.4	6.2	2.0	3.0	31.6	
	8	474	--	68.4	2.7	19.4	7.6	--	1.9	31.6	

Table 3.--Grade recovery of western hemlock Dimension lumber following kiln-drying
and surfacing; 1962 study in western Washington

Rough green lumber input				Grade recovery of surfaced dry lumber as percent of input									
Thickness and grade	Width	Corrected volume tested	Select Structural	Construc- tion	Standard	Utility	Economy	Cull and trim loss	Total degrade				
Inches Board feet:----- Percent -----													
2-inch Dimension:													
Select structural	4	6,768	75.9	0.7	6.3	14.8	1.6	0.7	24.1				
	6	7,012	74.8	1.4	10.6	11.0	.6	1.6	25.2				
	8	10,125	83.3	2.1	5.5	8.2	.8	.7	17.3				
	10	4,951	71.8	5.9	13.6	6.5	--	2.2	28.2				
Construction	4	9,520	--	78.1	4.6	14.5	1.9	.9	21.9				
	6	15,248	--	78.6	7.7	11.9	.6	1.2	21.4				
	8	7,761	--	77.5	2.6	16.6	2.3	1.0	22.5				
	10	16,980	--	80.6	8.3	9.2	.3	1.6	19.4				
Standard	4	6,753	--	--	83.8	13.7	2.0	.5	16.2				
	6	7,414	--	--	80.9	17.4	.8	.9	19.1				
	8	7,718	--	--	81.8	16.6	.9	.7	18.2				
	10	6,974	--	--	86.1	12.5	.4	1.0	13.9				
Utility	4	12,398	--	--	--	92.9	6.7	.4	7.1				
	6	7,378	--	--	--	94.5	5.2	.3	5.5				
	8	15,332	--	--	--	89.8	10.0	.2	10.2				
	10	6,404	--	--	--	93.3	6.4	.3	6.7				
Economy	4-10	21,707	--	--	--	--	99.6	.4	.4				

Table 4.--Seasoning, surfacing, and manufacturing degrade in kiln-dried western hemlock lumber.

1962 study in western Washington

Rough green lumber input			Proportion of input degraded during processing, by cause																			
Thickness and grade	Width	Corrected volume tested	Seasoning and surfacing defects										Manufacturing defects				Total degrade					
			Warp	Season check	End check	Planer split	Machine burn	Planner gouge	Planner Torn grain	Stain	Knots	Broken knots	Shake	Cull and trim loss	Thin	Sawed trim loss		Total				
																			Percent	Percent	Percent	
1-Inch Finish:																						
			Inches	Board feet																		
C & Better	4	914		2.6	0	0	0.6	0	0	7.6	0.6	0	0	0.1	11.5	19.3	23.4	2.1	1.1	45.9	57.4	
	6	1,958		2.6	1.7	0	1.0	0	0	2.1	0	0	0	1.0	8.4	14.4	26.6	1.4	.8	43.2	51.6	
	8	2,451		2.1	1.3	0	2.5	0	0	3.1	0	0	0	1.3	10.3	9.5	24.2	2.5	1.1	37.3	47.6	
D	4	59		0	0	0	0	0	0	0	0	0	0	0	0	30.6	0	0	0	30.6	30.6	
	6	196		0	2.0	0	0	0	0	0	0	0	1.5	3.5	12.8	13.8	0	1.5	26.1	31.6		
	8	474		1.9	0	0	1.6	0	0	0	0	0	1.9	5.4	8.9	17.3	0	0	26.2	31.6		
2-Inch Dimension:																						
Select structural	4	6,768		2.5	6.4	0	0	0	0	0	0	0.2	0.3	3.4	.4	13.2	4.7	4.7	1.1	.4	10.9	24.1
	6	7,012		2.0	10.7	0.3	0	0	0	0	0	.2	.2	3.1	1.0	17.5	3.6	1.4	2.1	.6	7.7	25.2
	8	10,125		0	9.8	.6	0	0	0	0	0	0	0	2.3	.4	13.3	1.1	1.5	1.1	.3	4.0	17.3
	10	4,951		0	12.6	.5	0	0	0	0	0	0	.5	.5	1.2	15.3	4.4	4.9	2.6	1.0	12.9	28.2
Construction	4	9,520		5.2	2.4	0	0	0	0	0	0	1.1	.1	1.8	.4	11.0	5.3	3.2	1.9	.5	10.9	21.9
	6	15,248		2.7	5.2	.1	0	0	0	0	1.4	1.3	3.4	1.0	15.1	3.4	1.2	1.5	.2	6.3	21.4	
	8	7,761		.3	12.7	.3	0	0	0	0	0	0	0	2.4	.7	16.7	1.0	2.4	2.1	.3	5.8	22.5
	10	16,980		0	11.0	.1	0	0	0	0	0	1.1	0	1.0	1.3	14.5	3.6	.7	.2	.4	4.9	19.4
Standard	4	6,753		2.0	2.9	0	0	0	0	0	0	1.4	.2	3.4	.3	10.2	2.6	2.9	.3	.2	6.0	16.2
	6	7,414		3.2	5.7	.2	0	0	0	0	0	2.2	.8	2.5	.5	15.1	1.5	1.1	1.0	.4	4.0	19.1
	8	7,718		0	8.3	.4	0	0	0	0	1.6	2.9	1.4	.6	15.2	.6	1.1	1.2	.1	3.0	18.2	
	10	6,974		.5	6.3	0	0	0	0	0	0	2.6	0	1.5	.6	11.5	.8	.4	.8	.4	2.4	13.9
Utility	4	12,398		1.0	.6	0	0	0	0	0	0	.1	0	4.1	.2	6.0	.3	.7	0	.1	1.1	7.1
	6	7,378		0	.7	.3	0	0	0	0	0	0	0	3.6	.2	4.8	0	0	.5	.2	.7	5.8
	8	15,332		.1	3.6	.3	0	0	0	0	0	.3	.1	5.0	.1	9.5	0	.4	.2	.1	.7	10.2
	10	6,404		0	.4	.7	0	0	0	0	0	0	0	4.5	.1	5.7	.5	0	.4	.1	1.0	6.7
Economy	4-10	21,707		0	0	0	0	0	0	0	0	0	0	0	.3	.3	0	0	0	.1	.1	.4

Table 5.--Loss in value of kiln-dried western hemlock lumber due to seasoning, surfacing, and manufacturing degrade;

1962 study in western Washington

Rough green lumber input				Cause of loss																Total loss in value			
				Seasoning and surfacing defects																Manufacturing defects		Total loss in value	